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Some Questions we never ask our Maths students *Affect and Metacognition*

FOONG PUI YEE

Introduction

Mathematics learning in school may be perceived by most students as an evaluative process which involves getting correct answers to mathematics problems; competing with peers; and with teachers placing emphasis on tests and examinations. In a study on anxiety and mathematics performance in a sample of female secondary students in Singapore (Foong, 1987), mathematics-anxious and underachieving students tended to have a negative perception of their mathematics teachers. They felt that their teachers were impersonal and not encouraging. It had not occurred to them that their mathematics teachers could find the time to be caring and responsive to their personal feelings besides teaching them how to solve mathematical problems and demanding 'correct' answers to a mass of sums. If the goals of the new mathematics curriculum (MOE, 1990) to develop positive attitudes, metacognition and a sense of personal achievement in mathematics are to be met, then teachers would have to rethink their classroom practices and start to ask reflective questions which they never ask their mathematics students, viz:

- * *What is the most important thing you have learnt in Maths this week?*
- * *What is the biggest worry affecting your work in Maths?*
- * *How do you usually feel during Maths lessons?*
- * *How could we improve Maths classes?*

- * *Which is your best/worst topic in Maths?*
- * *When you are stuck at a problem what would you usually do?*
- * *Why do you enjoy/dislike solving mathematics problems?*

It is the answers to questions like these rather than content-based questions or worksheets, that enable teachers to reflect on how their actions affect the classroom environment. This in turn guide them in planning their mathematics instruction.

Reflective Practices

There is increasing focus on the use of student journal writing to strengthen mathematics instruction. Scheibelhut (1994) and Buschman (1995) believe that through journal writing each child is actively involved in reflecting on what she or he has been doing in mathematics classrooms. Learning thus will become an active process of knowledge construction and sense-making by the student. At the same time, teachers on reading the children's writing could reflect on the teaching and learning process to gain better understanding of their students and how teacher-student interactions be improved for effective learning. Reported in the following sections are two small scale school-based studies, one conducted in a secondary and one in a primary school in Singapore. The teachers used journal writing as a technique to gain insight into their students' attitudes and metacognition toward the learning of mathematics. The rich information gathered will allow the teachers to tailor their daily lessons to meet specific needs of these different groups of students.

Combating Remedial Secondary Students' Mathophobia

In an effort to help a group of fifteen secondary three "express" students who were doing well in other subjects except mathematics, the teacher conducted a "math clinic" once a week for these students. One of the main aims was to help students overcome the fear of and negative attitudes toward mathematics, an affliction

commonly known as “mathophobia”. The students had to keep a journal where they were encouraged to do open-ended writing as a follow-up to lessons of the week about how they felt and what they learnt in mathematics. These were used as a feedback to the teachers concerned so that they could be attuned to the psychological needs of the students to make the necessary adjustment in their classroom interactions.

At the beginning of the “math clinic” students, were asked to write about the times when they had felt particularly good or bad during mathematics classes. Writing in journals lets students get rid of stress because instead of keeping their feelings bottled up, they can express them to the teacher on paper. As expected none of the students had any happy experiences to tell. Most of them felt badly about failing mathematics tests when they compared themselves to others. On reading the journals, the teacher would realise that students were suffering from test-anxiety and that the curriculum was putting undue pressure on these secondary three students by emphasising tests as a way to prepare them for their “o’ level mathematics.

The teacher should explore other forms of assessment such as group or pair work in a non-threatening atmosphere where these students are encouraged to raise doubts or explore various ways of solving a problem. It should be a more student-centred kind of instruction with a shift away from rote-learning and too much practice of ‘O’ level examination questions. Typical journal entries from these mathophobic students were:

- * *No matter how I practice, I still flung my maths. I feel very discouraged but I vow to myself that I must do better in the next test. Yes, I work. To my dismay, I failed again. It happened repeatedly. In the end I lost my confidence which affect my other subjects. All of a sudden, I feel inferior and stupid as compared to the others (always passing with flying colours). Thus I find mathematics quite boring.*
- * *Since I come up to Sec 3, I suddenly found that I could not catch up with the work. And for every set of homework I*

do, I did not know how, so I copied. Further more I never pass my A. Maths Tests. I really felt very discouraged and thought myself to be so lousy.

- * *I don't know why but mostly during maths tests and examinations my mind went blank and I can't think properly. I get angry with myself and when I get my results I started worrying because my results were so bad and I start to lose confidence.*

Some students wrote of their fear of speaking up and asking questions to clarify doubts in class:

- * *I can't fully understand what the teacher is trying to convey. Sometimes I feel like asking some questions in class. But I can't overcome the fact that the question may be a very simple question and yet I am asking it. I always think that the teacher may think I'm not paying attention in class when I ask questions.*
- * *During Maths lesson, I just can't concentrate and worst of all, I slept (when the teacher is too long-winded or if I don't understand). Usually, I don't have the guts to ask the teachers (I don't know why).*
- * *When the teacher asked me in the middle of a lesson, I felt awful and embarrassed when I couldn't answer correctly.*
- * *Actually I don't mind maths, but I realised that the teachers really affect me a lot. I used to have a very understanding teacher who helped me to improve my maths from 30/100 to 65/100. I paid full attention to her and hand in my homework on time. Now I am scared of my new maths teacher, every lesson I even go to the sick-bay to escape maths.*

Activating Upper-Primary Pupils' Metacognitive Knowledge

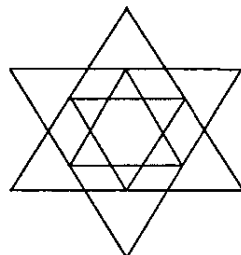
Research into metacognition has shown the potential value of equipping students to reflect on and even take control of their learning (Garofalo & Lester, 1985). Metacognition is the ability to reflect on cognitive activity, to know what strategies are appropriate in specific contexts, to know whether or not one possesses the skills or ability to perform certain tasks. Children also demonstrate metacognition when they express feelings and attitudes to the cognitive activities they are engaged in. Children can keep journals in which they reflect on what they have been engaged in during mathematics lessons.

A group of twenty primary five pupils attending an enrichment programme on problem solving at a local school were given reflective questions to answer during their journal writing times. These times were usually held at the last 10 or 15 minutes of a class session. Pupils who have good mathematics achievement were selected for this programme. The questions children had to answer and their responses were as follows:

Q1. Look at these three questions:

You do not have to do the questions now. Just look at them and say which one you would like to do first and which one you would leave till last. Give as many reasons as you can on your choice.

1. How many triangles are in this figure?



2. $0.125 \times 0.1225 \times 64 = \blacksquare$

3. Tina bought 7 apples and 5 pears. Each apple cost 45 cents and each per cost $\frac{1}{4}$ more than each apple. If she gave the shopkeeper \$10.00, how much change should she get?

Pupils' Responses

More than half of the children chose to do Question 1 first. Their reasons were ***“It was fun and interesting”, “I like shapes”, “It’s easiest because I do not need to calculate” and “I do first one first because I like to be orderly”***. Similarly more of them chose to do the third question last because ***“it was hard”, “the question will take more time for me to solve”, “I have to go through many calculations before I can get the answer”, “it has to write statements” and “I don’t like word problems.”***

Q2. What is the best thing that has happened in maths lessons this term?

Pupils' Responses

As these pupils selected for this enrichment programme were good achievers in mathematics, most of them seemed positive, responding such as ***“I was the best in class”, “I get high marks in maths”, “Games in maths”, “Teacher often asked me to answer questions” and “Nothing”***

Q3. What is your biggest worry in maths lessons?

Pupils' Responses

Some pupils were more competitive in attitude when they expressed feelings like ***“I cannot catch up with my friends”, “My biggest worry is people beating me at maths”***. Most of the others were worried about challenge problems, tests and exams and making mistakes.

Q4. How could maths classes be improved?

Pupils' Responses

Suggestions were ***“If we could have more time”, “more***

games and quizzes”, “working hard and concentrate”, “when I do more in the thing I’m weak in”, “if we listen to the teacher teaching us”. Lastly, a boy named Jack who did well in mathematics though obviously not his favourite subject wrote:

“Actually, maths is a very fun and interesting subject. You must do a lot to improve in it. But some people (like me) don’t like to do maths very much and think it’s a bother to them. But you must encourage yourself and try to like this subject”

Conclusion

The above studies demonstrate that given the opportunities, students in our schools can articulate their inner thoughts and feelings in writing to their teachers. It is another form of two-way interaction between teacher and students where more affective and metacognitive questions are asked. In our tight curriculum where much of the time is used for content coverage and emphasis on achievement scores, students’ feelings and fears are often neglected and not recognised as a likely cause for underachievement in the subject. And the situation can be a vicious cycle around negative attitudes and poor performance.

In response to student journal entries, teachers could reflect on their own behaviours by creating a supportive environment with a non-authoritarian view of mathematics by encouraging students to discuss with each other possible approaches to a problem or use activities or manipulatives to help students understand a particular concept, even at the expense of less coverage. Teachers could change the class atmosphere from one of tension and competition, and a resulting unwillingness to ask “dumb” questions, to one of trust. Games and puzzles may be introduced to help make mathematics more fun. Through students’ metacognitive report about their own learning, the teacher can help in inculcating good study habits and problem solving strategies.

It is therefore recommended that students be regularly given the opportunity, about once every two weeks, to give confidential

written answers to reflective questions like the ones mentioned above. The aims of such a practice are:

- * To provide an outlet whereby the student can regularly inform the teacher of difficulties experienced, help needed and anxiety felt.
- * To encourage and facilitate pupil-teacher dialogue, student reflection on learning, and negotiated instruction.

The possible benefits of such a practice are:

- * The teacher gains information on student difficulties.
- * Instruction may be made more appropriate.
- * Students' worries are given recognition.
- * Student-teacher relationship may improve.
- * Students develop the habit of reflecting on their own learning.

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